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(54) **CABLE CONNECTOR**

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Description

This invention relates to a cable connector, and in particular to a connector for interconnecting a high voltage electric power cable with high voltage apparatus, such as a transformer or switchgear. By 'high voltage' is meant a voltage in excess of 1kV, and may typically be in the range 10kV to 36kV.

Cable connectors suitable for this purpose are disclosed in EP-A-0225190 and EP-A-0139483 the entire contents of which are included herein by this reference. There is disclosed in EP-A-0225190 a cable connection arrangement in which an end of the cable is fully terminated and the connector is arranged to receive the terminated cable as a push-fit therein. A terminal then secures a conductive lug of the terminated cable to a contact member retained within the insulating body of the connector. The connector of EP-A-0139483 in addition to having the electrical contact member completely contained within the insulating body, receives the cable end, which need not be completely terminated, within a passageway that is heat-recoverable.

It is an object of the present invention to provide an improved cable connector.

In accordance with one aspect of the present invention, there is provided a high voltage cable connector comprising an electrically insulating and substantially non-tracking body having four sockets extending thereinto; wherein a first of the sockets is arranged to receive a bushing of high voltage electrical apparatus, a second of the sockets is arranged to recieve a plug, a third of the sockets is arranged to receive one end of a high voltage electric power cable, and a fourth of the sockets is arranged to receive a surge arrester; wherein the third and fourth sockets open into one another whereby the one end of the cable and one end of the surge arrester can be electrically connected together; within the insulating body and wherein the third and fourth sockets open into the second socket thereby in the absence of the plug to allow access through the second socket to said one ends of the cable and surge arrester for connection to each other and, in operation, to a terminal of the bushing of the electrical apparatus.

It is becoming increasingly desirable to provide protection for high voltage systems against overvoltage surges due, for example, to a short circuit or a lightning strike, and surge arresters (or surge diverters) are employed to do this. Surge arresters are normally non-conductive, but their rating is selected for a given high voltage system such that on occurrence of a voltage above a given value they become conductive and safely conduct fault current to earth before any damage is done to the system. The surge arrester then returns to its non-conductive state. The operative component of a surge arrester may comprise a nonlinear resistor arrangement formed from a plurality, that its to say two or more, of metal oxide, for example zinc oxide, varistor blocks stacked end-to-end, having a plate or other conductive member at each end to form a pair of electrodes. The resistor and electrode arrangement is mounted within and retained by a housing, which may be formed from a non-tracking insulating polymeric material or from porcelain. By 'non-tracking' material is meant a material that is resistant to the formation of carbonaceous paths therealong, and that satisfies the requirements of the ASTM D 2303 Inclined Plane test. The outer surface of the surge arrester may be convoluted and/or may of shedded configuration for enhanced electrical performance, particularly in adverse environmental conditions of salt, acids and humidity. The present invention thus provides overvoltage protection for a high voltage system in a particularly convenient manner by combining the features of cable connector and surge arrester in a single compact unit.

Preferably the insulating body of the connector contains a electric contact means that is arranged in operation, that is to say when a cable and a surge arrester are mounted in the connector and the connector is mounted on the electrical apparatus, to provide electrical connection between, on the one hand, the terminal of the bushing of the apparatus and, on the other hand, the said one end of the cable and of the surge arrester. Conveniently, the contact means may comprise a first elongate portion, which may be a pin or a socket, that extends into the first socket, a second elongate portion that extends into the second socket, and an intermediate portion that is mechanically retained by the insulating body of the connector. Preferably the first and second elongate portions extend freely into their respective sockets, i.e. without contacting the walls of those sockets, and advantageously they are aligned axially therealong. The surge arrester and cable when fitted to the connector preferably extend sealingly through their respective sockets in the insulating body and are connected to the second portion of the electrical contact member within the second socket. The plug is advantageously sealingly fitted into the second socket, and may receive, and mechanically support, the free end of the second portion of the contact member. The plug may be provided with a capacitive test point, accessible from outside the connector when the plug is mounted therein, for determination of voltage applied to the contact member.

A particularly compact configuration of connector can be obtained when the first and second sockets are substantially axially aligned with one another, and the third and fourth sockets extend transversely thereof substantially in the same plane and to the same side of the first and second sockets. The distance between the bushing of the electrical apparatus and the plug can thus be minimised whilst not only allowing for connection of the cable but also allowing for

the presence of the surge arrester. Such a configuration is particularly useful when the connector, and particularly three adjacent connectors of a three-phase system, need to be mounted within a cabinet which either needs to be as small as possible or is an existing cabinet that was not originally designed for a system incorporating a surge arrester.

The fitting of the cable into the connector may be as disclosed in EP-A-0225190 or as in EP-A-0139483. Using the former arrangement, one end of the electric cable extends sealingly into the insulating body through the third socket, an outer insulating jacket of the cable has been removed to expose an electrical screen of the cable, the screen has been removed to expose primary insulation of the cable, and the primary insulation has been removed to expose a conductor of the cable, and the cable is terminated by electrical stress control material that extends over the exposed end of the screen and along at least part of the exposed primary insulation, and by electrical insualtion material that extends in close conformity over the cable screen and over the stress control material.

In general, the sockets, but particularly the third and/or fourth sockets, may be arranged to receive the associated component as a push fit therein. In an alternative arrangement, one or more of the sockets, and in particular the third and/or fourth socket, may be recoverable, preferably by the application of heat thereto, in order to achieve sealing conformity with the associated component. An example of heat sealing a cable into a connector is shown in EP-A-0139483.

Although the entire surge arrester apart from its earthing terminal, may be enclosed within the fourth socket, it is envisaged that the body of the surge arrester may remain outside the connector and that a terminal extending from one end will be introduced through the fourth socket to make the required electrical connection.

A connector in accordance with the present invention will now be described, by way of example, with reference to the accompanying drawing, in which

Figure 1 shows the connector in sectional elevation with a calbe and surge arrester mounted therein; and

Figure 2 shows as detail of a connection lug.

Referring to the drawing, the connector has an insulating non-tracking body 2 of plastics material, such as EPDM. The body 2 has a first socket 4 that is of inwardly tapering and frusto-conical configuration. A second socket 6 of the body 2 has the same configuration and is axially aligned with the socket 4. A third socket 8, of circular section, leads into the connector body 2 perpendicularly to the sockets 4 and 6 and opens into the second socket 6. A fourth socket 10, of circular section, also leads into the connector body 2 perpendicularly to the first and second sockets 4 and 6, in the same plane and extending in the same general direction as the socket 8.

An annular metal contact disc 12, for example of brass or copper, is retained in a recess of the insulating body 2 at the junction of the first and second sockets 4, 6 and threadedly receives a conductive contact pin 14 therein such that a first portion 16 of the pin extends axially into the first socket 4 and a second portion 18 of the pin extends into the second socket 6.

A 15kV cable 20 that has been completely terminated and that has an outer sleeve 22 of heat-recoverable insulating, non-tracking polymeric tubing thereon and a metal connecting lug 24 (see also Figure 2) at the end thereof is sealingly inserted as a push-fit into the socket 8 so as to dispose the lug 24 around the contact pin 14 adjacent the contact-disc 12. The lug 24 is then secured in position by means of a nut 25 and a spring washer, access to do this being obtained via the socket 6.

A surge arrester 26 has an insulating, non-tracking housing 28, and is terminated at one end by an insulated rod 30 having a connecting lug 32 (see also Figure 2) at the free end thereof, and at the other end by an earthing stud 35. The rod 30 is sealingly inserted as a push-fit into the socket 10 so as to dispose the lug 32 around the contact pin 14 adjacent the cable locking nut 25. The lug 32 is then secured in position by a further nut 34 and a spring washer.

A back plug 36 of insulating plastics material is then sealingly inserted as a push-fit into the socket 6. The plug 36 has a metal insert 38 that slidably receives the free end of the second portion 18 of the contact pin 14. Thus, the pin 14 with the cable and surge arrester lugs 24,32 secured thereto is firmly mounted in the connector at two positions along its length.

The connector body 2 is mounted on electrical apparatus (not shown) such as a transformer or switchgear by having an insulating bushing 40 of the apparatus sealingly inserted as a push-fit into the socket 4. This action causes the first portion 16 of the contact pin 14 to engage with a conductive terminal 42 of the electrical apparatus that extends through the bushing 40.

As can be seen from Figure 1, with the insulating connector body 2, the cable 20, and the surge arrester 26 lying substantially in the same plane, and with the surge arrester 26 extending longitudinally beyond the back plug 36 by only a comparatively small amount, a very compact arrangement is obtained, that can conveniently be mounted within the confines of existing cabinets for cable terminations.

It will be clear that should any significant overvoltage appear on the terminal 42 of the electrical apparatus or on the conductor of the cable 20 (connected to its lug 24), the resulting current will be short-circuitted through the surge arrester 26 to earth at its stud 35.

Claims

1. A high voltage cable connector comprising an electrically insulating and substantially non-tracking body having four sockets extending thereinto; wherein a first of the sockets is arranged to receive a bushing of high voltage electrical apparatus, a second of the sockets is arranged to receive a plug, a third of the sockets is arranged to receive one end of a high voltage electric power cable, and a fourth of the sockets is arranged to receive a surge arrester; wherein the third and fourth sockets open into one another whereby the one end of the cable and one end of the surge arrester can be electrically connected together within the insulating body; and wherein the third and fourth sockets open into the second socket thereby in the absence of the plug to allow access through the second socket to said one ends of the cable and surge arrester for connection to each other and, in operation, to a terminal of the bushing of the electrical apparatus.

2. A connector according to claim 1, comprising electrical contact means mounted in the insulating body thereof, the contact means being arranged, in operation, to make electrical contact with the terminal of the bushing of the electrical apparatus and said one end of the cable and of the surge arrester.

3. A connector according to claim 2, wherein the electrical contact means comprises a first elongate portion that extends freely into the first socket, a second elongate portion that extends freely into the second socket and an intermediate portion that is mechanically retained by the insulating body of the connector.

4. A connector according to claim 2 or claim 3, comprising a surge arrester, wherein one end of the surge arrester extends sealingly into the insulating body through the fourth socket and is connected to electrical contact means.

5. A connector according to any one of claims 2 to 4, wherein one end of an electric cable extends sealingly into the insulating body through the third socket and is connected to electrical contact means.

6. A connector according to any of claims 2 to 5, comprising a plug that is sealingly inserted in the second socket and that receives an end of the electrical contact means.

7. A connector according to any preceding claim, wherein the first and second sockets are substantially axially aligned with one another, and wherein the third and fourth sockets extend transversely thereof substantially in the same plane.

8. A connector according to any preceding claim wherein the third and/or fourth sockets are arranged to receive the cable or surge arrester respectively as a push-fit therein.

9. A connector according to claim 8, wherein one end of an electric cable extends sealingly into the insulating body through the third socket; wherein an outer insulating jacket of the cable has been removed to expose an electrical screen of the cable, the screen has been removed to expose primary insulation of the cable, and the primary insulation has been removed to expose a conductor of the cable; wherein the cable is terminated by electrical stress control material that extends over the exposed end of the screen and along at least part of the exposed primary insulation, and by electrical insulation material that extends in close conformity over the cable screen and over the stress control material; and wherein the third socket is arranged to receive the terminated cable as a push-fit therein.

10. A connector according to any one of claims 1 to 7, wherein the third and/or fourth sockets are recoverable, preferably by heat, on to the cable or surge arrester respectively.

Patentansprüche

1. Hochspannungskabelverbinder mit einem elektrisch isolierenden und im wesentlichen kriechstromfesten Körper mit vier Buchsen, die sich in den Körper erstrecken;
wobei eine erste Buchse zur Aufnahme einer Durchführung einer elektrischen Hochspannungsvorrichtung angeordnet ist, eine zweite Buchse zur Aufnahme eines Steckers angeordnet ist, eine dritte Buchse zur Aufnahme des einen Endes eines elektrischen Hochspannungsversorgungskabels angeordnet ist und eine vierte Buchse zur Aufnahme eines Überspannungsschutzes angeordnet ist;
wobei sich die dritte und vierte Buchse ineinanderöffnen, so daß das eine Ende des Kabels und das eine Ende des Überspannungsschutzes innerhalb des isolierenden Körpers elektrisch miteinander verbunden werden können;
und wobei sich die dritte und die vierte Buchse in die zweite Buchse öffnen, um dadurch bei Abwesenheit des Steckers den Zugang durch die zweite Buchse zu den einen Enden des Kabels und

des Überspannungsschutzes zur Verbindung miteinander und, im Betrieb, mit einem Anschluß der Durchführung der elektrischen Vorrichtung zu ermöglichen.

2. Verbinder nach Anspruch 1, der eine in seinem Isolierkörper angebrachte elektrische Kontakteinrichtung aufweist, wobei die Kontakteinrichtung im Betrieb so angeordnet ist, daß sie einen elektrischen Kontakt mit dem Anschluß der Durchführung der elektrischen Vorrichtung und dem einen Ende des Kabels und des Überspannungsschutzes herstellt.

3. Verbinder nach Anspruch 2, wobei die elektrische Kontakteinrichtung einen ersten langgestreckten Bereich, der sich frei in die erste Buchse erstreckt, einen zweiten langgestreckten Bereich, der sich frei in die zweite Buchse erstreckt, sowie einen Zwischenbereich aufweist, der von dem Isolierkörper des Verbinders mechanisch zurückgehalten wird.

4. Verbinder nach Anspruch 2 oder 3, der einen Überspannungsschutz aufweist, wobei das eine Ende des Überspannungsschutzes sich abdichtend durch die vierte Buchse in den Isolierkörper erstreckt und mit der elektrischen Kontakteinrichtung verbunden ist.

5. Verbinder nach einem der Ansprüche 2 bis 4, wobei das eine Ende eines elektrischen Kabels sich abdichtend durch die dritte Buchse in den Isolierkörper erstreckt und mit der elektrischen Kontakteinrichtung verbunden ist.

6. Verbinder nach einem der Ansprüche 2 bis 5, mit einem Stecker, der abdichtend in die zweite Buchse eingeführt ist und ein Ende der elektrischen Kontakteinrichtung aufnimmt.

7. Verbinder nach einem der vorhergehenden Ansprüche, wobei die erste und die zweite Buchse im wesentlichen axial miteinander ausgerichtet sind, und wobei sich die dritte und die vierte Buchse im wesentlichen in derselben Ebene quer dazu erstrecken.

8. Verbinder nach einem der vorhergehenden Ansprüche, wobei die dritte und/oder die vierte Buchse zur formschlüssigen Aufnahme des Kabels bzw. des Überspannungsschutzes angeordnet sind.

9. Verbinder nach Anspruch 8, wobei das eine Ende eines elektrischen Kabels sich abdichtend durch die dritte Buchse in den Isolierkörper erstreckt; wobei ein äußerer Isoliermantel des Kabels entfernt worden ist, um eine elektrische Abschirmung des Kabels freizulegen, die Abschirmung entfernt worden ist, um die Primärisolierung des Kabels freizulegen, und die Primärisolierung entfernt worden ist, um einen Leiter des Kabels freizulegen; wobei das Kabel mit einem Material zur Kontrolle der elektrischen Belastung, das sich über das freigelegte Ende der Abschirmung und wenigstens entlang eines Teils der Primärisolierung erstreckt, sowie mit einem elektrischen Isoliermaterial abgeschlossen ist, das sich in dichter Anpassung über die Kabelabschirmung und über das Material zur Belastungskontrolle erstreckt; und wobei die dritte Buchse zur formschlüssigen Aufnahme des abgeschlossenen Kabels angeordnet ist.

10. Verbinder nach einem der Ansprüche 1 bis 7, wobei die dritte und/oder die vierte Buchse, bevorzugt durch Wärme, auf das Kabel bzw. den Überspannungsschutz rückstellbar sind.

Revendications

1. Connecteur de câble à haute tension comprenant un corps électriquement isolant et ne formant sensiblement aucun trajet conducteur, ce corps comportant quatre douilles qui pénètrent en lui, une première des douilles étant conçue pour loger un manchon d'un appareil électrique sous haute tension, une deuxième des douilles étant conçue pour loger un bouchon, une troisième des douilles étant conçue pour loger une extrémité d'un câble de transport d'énergie électrique sous haute tension et une quatrième des douilles étant conçue pour loger un système de protection contre les surtensions, les troisième et quatrième douilles s'ouvrant l'une sur l'autre de façon qu'une extrémité du câble et une extrémité du système de protection contre les surtensions puissent être connectées électriquement l'une à l'autre à l'intérieur du corps isolant et les troisième et quatrième douilles s'ouvrant dans la deuxième douille de manière à permettre, en l'absence du bouchon, l'accès par la deuxième douille auxdites extrémités du câble et du système de protection contre les surtensions pour permettre de les connecter l'une à l'autre et, en fonctionnement, à une borne du manchon de l'appareil électrique.

2. Connecteur selon la revendication 1, comportant un moyen de contact électrique monté dans son corps isolant, le moyen de contact étant conçu de

manière qu'il établisse en fonctionnement le contact électrique avec la borne du manchon de l'appareil électrique et avec ladite une extrémité du câble et celle du système de protection contre les surtensions.

3. Connecteur selon la revendication 2, dans lequel le moyen de contact électrique comporte une première partie allongée qui pénètre librement dans la première douille, une seconde partie allongée qui pénètre librement dans la deuxième douille et une partie intermédiaire qui est retenue mécaniquement par le corps isolant du connecteur.

4. Connecteur selon la revendication 2 ou la revendication 3, comportant un système de protection contre les surtensions, une extrémité du système de protection contre les surtensions pénétrant de manière étanche dans le corps isolant par la quatrième douille et étant connectée au moyen de contact électrique.

5. Connecteur selon l'une quelconque des revendications 2 à 4, dans lequel une extrémité du câble électrique pénètre de manière étanche dans le corps isolant par la troisième douille et est connectée au moyen de contact électrique.

6. Connecteur selon l'une quelconque des revendications 2 à 5, comportant un bouchon qui est introduit de manière étanche dans la deuxième douille et qui loge une extrémité du moyen de contact électrique.

7. Connecteur selon l'une quelconque des revendications précédentes, dans lequel les première et deuxième douilles sont sensiblement alignées axialement l'une sur l'autre et dans lequel les troisième et quatrième douilles sont disposées perpendiculairement aux précédentes et sont sensiblement dans le même plan.

8. Connecteur selon l'une quelconque des revendications précédentes, dans lequel les troisième et/ou quatrième douilles sont conçues pour loger le câble ou le système de protection contre les surtensions, respectivement, par ajustement par poussée.

9. Connecteur selon la revendications 8, dans lequel une extrémité d'un câble électrique pénètre de manière étanche dans le corps isolant par la troisième douille, dans lequel une gaine isolante extérieure du câble a été enlevée pour mettre à découvert un blindage électrique du câble, le blindage a été enlevé pour mettre à découvert la première isolation du câble et la première isolation a été enlevée pour mettre à découvert un conducteur du câble et dans lequel le câble est terminé par une matière de commande de la contrainte électrique qui est disposée sur l'extrémité à découvert du blindage et le long d'au moins une partie de la première isolation mise à découvert ainsi que par une matière d'isolation électrique qui est placée sur le blindage du câble en épousant étroitement sa forme et sur la matière de commande de la contrainte et dans lequel la troisième douille est conçue pour loger la terminaison du câble par ajustement par poussée.

10. Connecteur selon l'une quelconque des revendications 1 à 7, dans lequel les troisième et/ou quatrième douilles sont douées de reprise de forme, de préférence à chaud, sur le câble ou sur le système de protection contre les surtensions, respectivement.

Fig. 1.

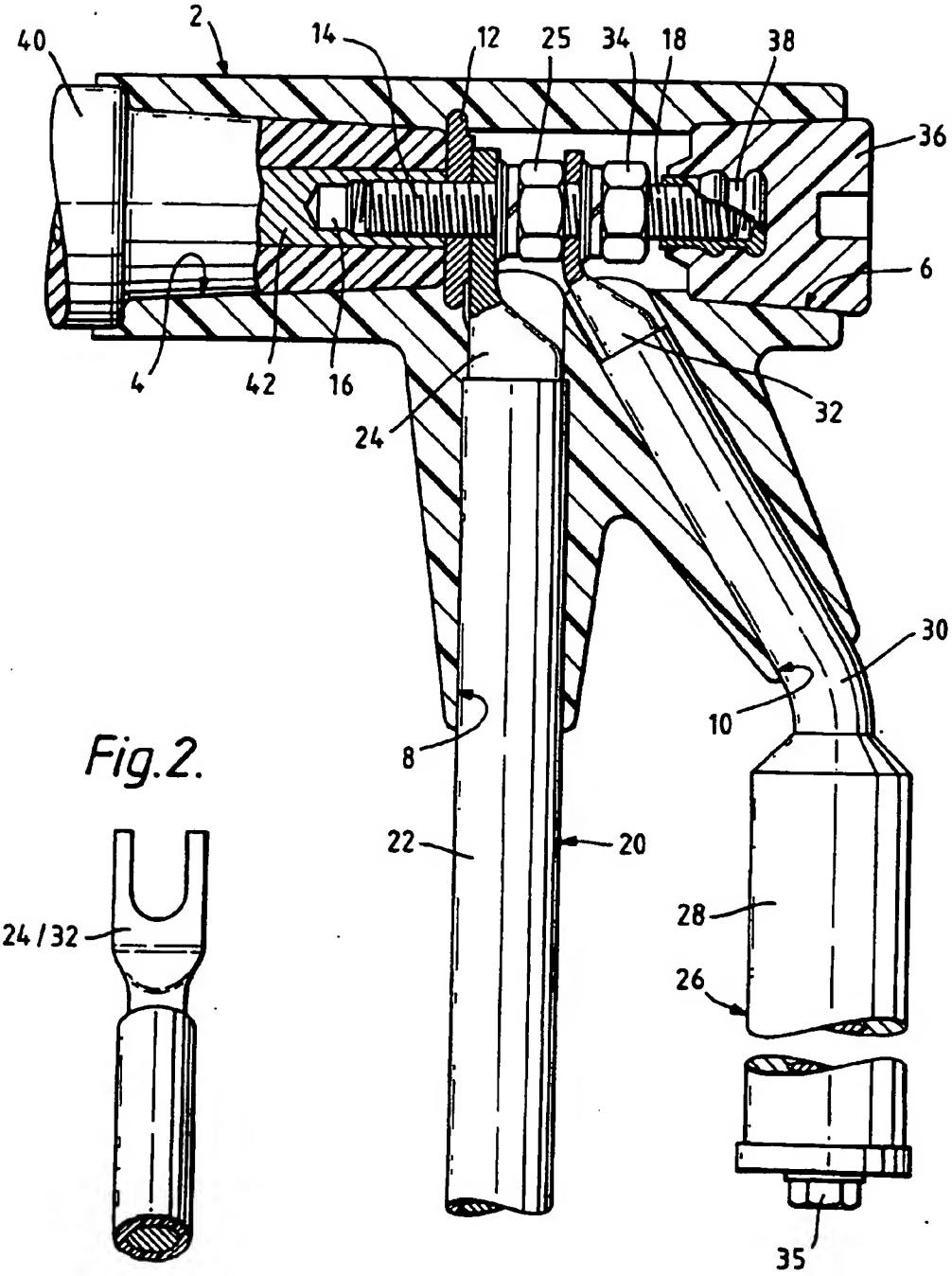

Fig. 2.